Table 1 - Summary of Final Remediation Goals Established by EPA for PCBs
OU1 Feasibility Study Report—Allied Paper, Inc./ Portage Creek/Kalamazoo River Superfund Site

Medium	Pathway	Exposure Scenario	PCB FRG	Basis
Soils	Human Health	Residential	1.0 mg/kg[a]	40 CFR § 761.61(a)(4)
		Non-Residential	10 mg/kg[b]	40 CFR § 761.61(a)(4)
		Recreational	23 mg/kg[c]	HHRA
	Ecological	Aquatic	0.5–0.6 mg/kg	BERA
		Terrestrial	6.5–8.1 mg/kg	BERA
Subsurface Soils	Human Health	Residential	1.0 mg/kg[a]	40 CFR § 761.61(a)(4)
		Non-Residential	10 mg/kg[b]	40 CFR § 761.61(a)(4)
Surface and Subsurface Sediments	Human Health	Recreational	23 mg/kg[c]	HHRA
		Terrestrial	6.5–8.1 mg/kg	BERA
		Fish Consumption	0.33 mg/kg[c,d]	HHRA
	Ecological	Aquatic	0.5–0.6 mg/kg	BERA
Groundwater (including seeps)	Human Health	Direct Contact	3.3 µg/L[e]	MI Part 201 direct contact criteria
		Groundwater-Surface Water Interface (GSI)	0.2 µg/L[f]	MI Part 201 GSI criteria
Residuals	N/A	Qualitative: Where an excavation is proposed, all visible residuals are to be removed unless analytical data are available to confirm PCBs (if present) are below applicable criteria.		

Notes:

[a] Based on high-occupancy cleanup level (without conditions) set forth in 40 CFR § 761.61(a)(4).

[b] Based on 40 CFR § 761.61(a)(4) with restrictive covenant prohibiting residential use.

[c] Based on recreational exposure as developed in HHRA.

[d] Default sediment criteria of 0.33 mg/kg will be applied to shallow soil in areas of periodic inundation due to the potential runoff of shallow soils into surface water. Evaluation of contaminated soil runoff to surface water required under R299.5728(f).

[e] Groundwater for use as drinking water is not considered a complete pathway so the Part 201 Drinking Water criteria of 0.5 microgram per liter (µg/L) was not used. The Part 201 direct contact criteria were used for protection of human health due to the presence of seeps.

[f] The groundwater criteria protective of surface water is a FRG where the GSI is present (MCL 324.20120e and Part 31).

BERA = baseline ecological risk assessment; HHRA = human health risk assessment; mg/kg = milligrams per kilogram;

N/A = not applicable

Source: CH2M HILL 2009

Table 2 - Summary of Final Remediation Goals for COCs other than PCBs
Allied Landfill—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

	Soils/Sediments (µg/kg)					Groundwater and Seeps [a] (µg/L)	
Analyte	Statewide Default Background Level	Residential Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria and RBSLs	Residential Direct Contact Criteria & RBSLs	Non-Residential Direct Contact Criteria & RBSLs	Residential Drinking Water Criteria & RBSLs	Groundwater Surface Water Interface Criteria & RBSL
SVOCs							
4-methylphenol	N/A	7,400	1,000	11,000,000	36,000,000	370	30
PCDD/PCDF [b]							
Total TCDD Equivalent(O)	N/A	NLL	NLL	0.09	0.99	N/A	
Inorganics							
Aluminum (B)	6,900,000	1,000	N/A	50,000,000	370,000,000	50	N/A
Antimony	N/A	4,300	94,000	180,000	670,000	6	130
Arsenic	5,800	4,600	4,600	7,600	37,000	10	10
Barium (B)	75,000 [c]	1,300,000	660,000 (G)	37,000,000	130,000,000	2,000	1,000 (G)
Cadmium (B)	1,200 [c]	6,000	3,000 (G)	550,000	2,100,000	5	2.5 (G)
Chromium	N/A	30,000	3,300	2,500,000	9,200,000	100	11
Cobalt	6,800	800	2,000	2,600,000	9,000,000	40	100
Copper	32,000 [c]	5,800,000	100,000 (G)	20,000,000	73,000,000	1,000	18 (G)
Cyanide	390	4,000	100	12,000	250,000	200	5.2
Iron (B)	12,000,000	6,000	N/A	160,000,000	580,000,000	300 (E)	N/A
Lead (B)	21,000 [c]	700,000	2,500,000 (G)	400,000	900,000	4	14 (G)
Magnesium (B)	N/A	8,000,000	N/A	1,000,000,000	1,000,000,000	400,000	N/A
Manganese (B)	440,000	1,000	26,000 (G)	25,000,000	90,000,000	50	1,300 (G)
Mercury	130	1,700	50	160,000	580,000	2	0.0013
Nickel	20,000 [c]	100,000	100,000 (G)	40,000,000	150,000,000	100	100 (G)
Selenium	410	4,000	400	2,600,000	9,600,000	50	5
Zinc	47,000 [c]	2,400,000	230,000 (G)	170,000,000	630,000,000	2,400	235 (G)

[a] Only the data from the 2002–2003 groundwater and seep samples are summarized to reflect conditions after removal.
[b] Dioxin and furans only were sampled in 1998.
[c] Background value used in RI as screening criteria; lowest risk-based level highlighted used for COC comparison.

N/A = Not Applicable, NLL= Not likely to leach, RBSL = risk-based screening level, µg/kg = micrograms per kilogram
(B) Background, as defined in R 299.5701(b), may be substituted if higher than the calculated cleanup criterion.
(E) Criterion is the aesthetic drinking water value, as required by § 20120a(5) of NREPA 1994 PA 451, as amended by NREPA of 1994.
(G) Calculated value dependent on ph, hardness.
(O) The concentration of all polychlorinated and polybrominated dibenzodioxin and dibenzofuran isomers present at a facility, expressed as an equivalent concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin based upon their relative potency, shall be added together and compared to the criteria for 2,3,7,8- tetrachlorodibenzo-p-dioxin.
Highlighted cells = lowest applicable criteria.
Source: Non-Residential Part 201 Generic Cleanup Criteria and Screening Levels; Part 213 Tier 1 Risk-Based Screening Levels, document release date March 25, 2011.

TABLE 3

Summary of VOCs, SVOCs, Pesticides, PCDD/PCDF, and Inorganic Exceedances

OU1 Feasibility Study Report—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

Analyte	Surface Soils	Subsurface Soils	Surface Sediments	Subsurface Sediments	Groundwater[a]	Seeps[a]
VOCs						
Carbon Tetrachloride		1/54				
Acetone			1/2			
SVOCs						
Acenaphthene			1/2			
Carbazole			1/2			
Dibenzofuran			1/2			
Phenanthrene		1/54				
4-methylphenol		12/54				
Naphthalene		1/54	1/2			
Pentachlorophenol		1/54	1/2			
Pesticides						
None						
PCDD/PCDF[b]						
Total TCDD Equivalent	1/8					
Inorganics						
Aluminum	1/2	26/55			5/72	1/37
Antimony		7/55				
Arsenic	1/2	9/54	1/2		23/72	10/37
Barium		23/55	1/2	1/1	4/72	4/37
Cadmium		5/55				
Chromium	2/2	53/55	2/2	1/1	1/72	
Cobalt		6/55				
Copper		23/55		1/1		
Cyanide		21/54			4/72	3/37
Iron	1/2	8/55	1/2	1/1	64/72	31/37
Lead	1/2	20/55	1/2	1/1	1/72	
Magnesium		13/55				
Manganese		4/55			66/72	36/37
Mercury		20/55		1/1		
Nickel		1/55		1/1	4/72	1/37
Selenium		10/55	1/2	1/1		
Silver				1/1	2/72	
Sodium					4/72	
Vanadium					1/72	1/37
Zinc		28/45	1/2	1/1	7/72	

Note:
x/y = number of samples (x) exceeding screening level criteria out of number of samples (y)
[a] Only the data from the 2002/2003 groundwater and seep samples are summarized to reflect conditions after removal
[b] Dioxin and furans only sampled in surface soils in 1998
PCDD = polychlorinated dibenzodioxins; PCDF = polychlorinated dibenzofurans

TABLE 4
Summary of Short-term Effectiveness Considerations
Allied Landfill—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

▪ Alternative	▪ Total Area Addressed	▪ Total Volume of COC-Containing Materials Excavated	▪ Duration	▪ Worker Risks	▪ Community Impacts
Alternative 1	No areas addressed	No volume of impacted PCB-containing materials addressed	No time period to implement	No worker risks from implementation as no action is taken.	Potential off-site migration of COC-containing materials.
Alternative 2A	65 acres, 48 acre cap	350,000 yd3	Approximately 2 years	Least of the active alternatives; managed by health and safety plan.	Associated with dust, noise, and truck traffic.
Alternative 2B	65 acres, 42 acre cap	479,000 yd3	Approximately 2 years	Slightly increased due to moving Monarch HRDL; managed by health and safety plan.	Slightly increased due to dust, noise, and truck traffic.
Alternative 2C	65 acres, 42 acre cap	479,000 yd3	Approximately 2 years	Greater than 2A and 2B due to potential exposure during characterization and transportation.	Greater than 2A and 2B due to additional management for characterization and off-site transport.
Alternative 2D	65 acres, 27 acre cap	920,000 yd3	Approximately 3 years	Greater than 2A, 2B, or 2C due to increased excavation and consolidation volume.	Greater than 2A, 2B, and 2C due to longer construction duration and transport of backfill materials.
Subalternative (i)	N/A	N/A	Concurrent with Alternative 2 Options, but indefinite O&M	Risks are easily managed by health and safety plan. Continued risks present with operation and maintenance of treatment system.	Slightly increased over Alternative 2 options during construction due to well installation and treatment system construction.
Subalternative (ii)	N/A	N/A	Concurrent with Alternative 2 Options, but indefinite O&M	Greater risks than subalternative (i) due to construction of slurry wall. Similar O&M risks.	Slightly increased over Alternative 2 options during construction due to well installation and treatment system construction. Greater than subalternative (i) due to slurry wall construction.
Alternative 3	65 acres	1,600,000 yd3	5 years	Greater than Alternative 2 given the area/volume of targeted material;	Greater than Alternative 2 due to noise, dust, and increased truck

TABLE 4
Summary of Short-term Effectiveness Considerations
Allied Landfill—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

Alternative	Total Area Addressed	Total Volume of COC-Containing Materials Excavated	Duration	Worker Risks	Community Impacts
				increased travel for disposal and increased project duration.	traffic, which would average 115 trips daily in and out of OU1 for the duration of the project. Greatest number of miles driven due to volume transported to disposal facilities with limited locations.
Alternative 4	65 acres, 48 acre landfill	1,600,000 yd3	10 years	Greater than Alternatives 2 and 3 given the area/volume of targeted material and significantly increased project duration.	Greater than Alternatives 2 and 3 due to noise and dust over the longest project duration. Slightly fewer truck trips than Alternative 3, but 1/3 of the miles outside OU1 due to decreased volume transported to disposal facilities.

Table 5

- **Comparative Analysis of Alternatives**

Allied Landfill—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

▪ Alternative	▪ Description	▪ Overall Protection	▪ Compliance with ARARs	▪ Long-term Effectiveness	▪ Reduction of Toxicity, Mobility, or Volume through Treatment	▪ Short-term Effectiveness	▪ Implementability	▪ Cost
Alternative 1	**No action**	Not protective. No action would be taken.	Would not meet ARARs	Not effective. Site conditions would remain the same.	No reduction of toxicity, mobility, or volume.	No worker risks. No action to be taken.	Implementable as no action would be taken.	$110,000
Alternative 2	**Consolidation and capping**							
2A	Construct caps on both Monarch and Operations areas	Protective. Remaining exposed contamination would be covered and contained. Infiltration of surface water would be minimized.	Meets ARARS	Effective. Larger landfill footprint requiring O&M than Alternatives 2B, 2C, and 2D.	No reduction of toxicity, mobility, or volume would be achieved.	Implementation over 2-year period, most effective of active alternatives. Worker risk associated with dermal contact, inhalation, and ingestion. Risks are controllable. Community impacts: associated dust, noise, and traffic.	Proven technology has been implemented at similar OUs.	$44,000,000
2B	Consolidate Monarch within Operations areas	Protective. Remaining exposed contamination would be covered and contained. Consolidation of the Monarch HRDL within the operations area would reduce the amount of monitoring required.	Meets ARARS	Effective	No reduction of toxicity, mobility, or volume would be achieved.	Implementation over 2-year period, slightly longer than 2A. Worker risk associated with dermal contact, inhalation, and ingestion. Risks are controllable. Community impacts: associated dust, noise, and traffic.	Proven technology has been implemented at similar OUs. Combining Monarch on the Operations Area would reduce the footprint of contamination.	$43,000,000
2C	Consolidate Monarch within operations areas and transport excavated soils with PCBs >500 mg/kg off site for incineration	Protective. Remaining exposed contamination would be covered and contained. Consolidation of the Monarch HRDL within the operations area would reduce the amount of monitoring required. Off-site incineration of some of the highest PCB concentrations would be slightly more protective.	Meets ARARs	Effective	Reduction of toxicity and volume would be achieved through treatment of a portion of the material.	Implementation over 2-year period, slightly longer than 2A and 2B. Worker risk associated with dermal contact, inhalation, and ingestion due to increased management with characterization and segregation. Risks are controllable. Community impacts: associated dust, noise, traffic, and off-site transportation of contaminated materials.	Proven technology has been implemented at similar OUs. Combining Monarch on the operations area would reduce the footprint of contamination. TSCA-permitted incinerators are in limited quantity. Identifying, segregating and shipping make 2C more difficult to implement.	$70,000,000
2D	Consolidate Monarch and portions of Operations Areas under an approximate 27 acre cap.	Protective. Remaining exposed contamination would be covered and contained.	Meets ARARs	Effective. Increased O&M requirements over Alternatives 2A, 2B, and 2C. Community stewardship may help facilitate the monitoring and maintenance of the cap and effectiveness of controls. Provides larger clean buffer along Portage Creek.	No reduction of toxicity, mobility, or volume would be achieved.	Implementation over 3-year period is longer than 2A, 2B, or 2C resulting in increases to worker risk associated with inhalation and ingestion. Community impacts: associated dust and noise during construction and increased traffic associated with trucking backfill materials.	Proven technology has been implemented at similar OUs. Implementability challenges are increased due to the consolidation on a smaller footprint resulting in a taller landfill. Additional stabilization measures may be required.	$63,000,000

Table 5

- **Comparative Analysis of Alternatives**

Allied Landfill—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

▪ Alternative	▪ Description	▪ Overall Protection	▪ Compliance with ARARs	▪ Long-term Effectiveness	▪ Reduction of Toxicity, Mobility, or Volume through Treatment	▪ Short-term Effectiveness	▪ Implementability	▪ Cost
Subalternative (i)	Groundwater collection and treatment system	Protective. Achieves RAO 3 with collection and treatment of potentially impacted groundwater.	Meets ARARs	Effective	Provides some reduction of volume through treatment of PCBs in groundwater. However, minimal contaminant mass is present in the groundwater.	Manageable risk associated with the installation of wells and construction of treatment system.	Proven technology.	$4,400,000 for Alternative 2A $4,300,000 for Alternative 2B, 2C or 2D
Subalternative (ii)	Groundwater collection and treatment system with slurry wall	Achieves RAO 3 with collection and treatment of potentially impacted groundwater, but may create mounding or otherwise alter groundwater flow.	Meets ARARs	Effective	Provides some reduction of volume through treatment of PCBs in groundwater. However, minimal contaminant mass is present in the groundwater.	Increased short-term risks to construction worker and environment over subalternative (i) during installation of the slurry wall. Community impacts; associated dust, noise, and traffic associated with slurry wall construction.	Proven technology. Implementation may result in groundwater mounding or short-circuiting around the barrier if operation of the groundwater treatment system ceased.	$14,000,000 for Alternative 2A $12,000,000 for Alternative 2B, 2C or 2D
Alternative 3	**Total Removal and Off-site Disposal**	Protective. Contamination would be disposed of at an approved landfill facility both hazardous and non-hazardous.	Meets ARARS	More effective than Alternative 2 due to removal from OU1. No cover maintenance or source for potential groundwater impacts.	No reduction of toxicity, mobility, or volume would be achieved. Volume may be increased if soils require dewatering by addition of cement.	Implementation over 5-year period. Worker risk associated with dermal contact, inhalation and ingestion would occur over a longer period of time. Risks are controllable. Community impacts: associated dust, noise, and traffic.	Proven technology, landfill space in the area could be limited requiring the hauling of waste a significant distance from OU1.	$238,000,000
Alternative 4	**Encapsulation Containment System**	Protective. Little advantage achieved by construction of the liner. Compacted waste can already achieve 1×10^{-7} centimeters per second hydraulic conductivity, limiting groundwater flow through the material.	Meets ARARS	More effective than Alternative 2. The source material is fully encapsulated further minimizing potential for groundwater impacts.	No reduction of toxicity, mobility, or volume would be achieved.	Implementation over 10-year period. Worker risk associated with dermal contact, inhalation, and ingestion would occur over a longer period of time. Risks are controllable. Community impacts: associated dust and noise is the least short-term effective alternative.	Proven technology.	$159,000,000